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EXAMINER	
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ART UNIT	**PAPER NUMBER**
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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/088,427	Applicant(s) WANG ET AL.	
	Examiner R. Michelle Vestal	Art Unit 1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 30 September 2002.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-32 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-32 is/are rejected.

7)☒ Claim(s) 2, 13 and 18 is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 30 September 2002 is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Priority

Receipt is acknowledged of papers submitted under 35 U.S.C. 120, which papers have been placed of record in the file.

Drawings

New corrected drawings in compliance with 37 CFR 1.121(d) are required in this application because all of the figure numbers in Figure 1 are not clearly written, Figures 4 and 7 have crossed out numbering, the text and numbering (primes and double prime numbers) in Figures 5 and 6 are not clearly written, Figure 7 has illegible text in the drawing title and is also labeled as Figure 6 (at bottom of drawing). Applicant is advised to employ the services of a competent patent draftsperson outside the Office, as the U.S. Patent and Trademark Office no longer prepares new drawings. The corrected drawings are required in reply to the Office action to avoid abandonment of the application. The requirement for corrected drawings will not be held in abeyance.

Specification

The disclosure is objected to because of the following informalities:

Page 6, lines 21-23 contain an incomplete sentence.

Page 11, line 12 the symbol for microamperes should be "μA."

Page 12, lines 8-9 please delete the reference to Attorney Docket No. DP-300023 and add the phrase "now abandoned" after "January 3, 2000."

Appropriate correction is required.

Claim Objections

Claims 2, 13 and 18 are objected to because of the following informalities:

Claim 2, line 2 please insert the word "the" between the words "of" and "reference."

Claim 13, line 2 the phrase "further comprises a second chamber" is included twice. Please correct the redundancy.

Claim 18, line 3 please insert the word "the" between the words "of" and "reference."

Appropriate correction is required.

The numbering of claims is not in accordance with 37 CFR 1.126 which requires the original numbering of the claims to be preserved throughout the prosecution. When claims are canceled, the remaining claims must not be renumbered. When new claims are presented, they must be numbered consecutively beginning with the number next following the highest numbered claims previously presented (whether entered or not).

Misnumbered claims 32 and 33 have been renumbered 31 and 32, respectively.

Claim Rejections - 35 USC § 112

Claims13 and 29 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 13 recites the limitation "the first diffusion path" in lines 4 and 6. There is insufficient antecedent basis for this limitation in the claim.

Claim 29 recites the limitation "the first diffusion path" in lines 4 and 6. There is insufficient antecedent basis for this limitation in the claim.

Claim 29 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claim 29 is dependent on itself. For examination purposes, claim 29 has been interpreted has being dependent on claim 28.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 10 and 11 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent Number 5,413,683 to Murase et al. (Murase).

Regarding claim 1, Murase discloses a gas sensor (Fig. 4, **50**) comprising a first electrode (Fig. 4, **60**) and a reference electrode (Fig. 4, **64**) with an electrolyte disposed there between (Fig. 4, **52**), wherein the first electrode and reference electrode are in ionic communication (Col. 9, lines 49-54), and a reference gas channel in fluid communication with the reference electrode and an exterior of the sensor (Fig. 4, **66**), wherein the reference gas chamber has a diffusion limiter (Fig. 4, **62**).

Regarding claims 10 and 11, Murase discloses that the reference gas channel further comprises an oxygen storage material (platinum) (Col. 6, lines 19-26).

Claims 1 and 12 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent Number 5,632,883 to Hoetzel.

Regarding claim 1, Hoetzel discloses a gas sensor (Col. 1, lines 6-8) comprising a first electrode (Fig. 1, **4**) and a reference electrode (Fig. 1, **5**) with an electrolyte disposed there between (Fig. 1, **3**), wherein the first electrode and reference electrode are in ionic communication (Col. 1, lines 53-56), and a reference gas channel in fluid communication with the reference electrode and an exterior of the sensor (Fig. 1, **6**), wherein the reference gas chamber has a diffusion limiter (Fig. 1, **10** and Col. 2, lines 41-44).

Hoetzel discloses the limitations of claim 12, wherein the reference gas channel comprises a first chamber (Fig. 1, **6**) disposed adjacent to the reference electrode (Fig. 1, **5**), wherein the first chamber has a cross-sectional area greater than a diffusion limiter (Fig. 1, **10**) cross-sectional area.

Claims 1-4, 10, 11 and 15 are rejected under 35 U.S.C. 102(e) as being anticipated by Japanese Patent Application Publication Number 10-160704. The English-language equivalent, U.S. Patent Number 6,007,688 to Kojima et al. (Kojima), will be referenced in this office action.

Regarding claim 1, Kojima discloses a gas sensor (Fig. 5B, **43**) comprising a first electrode (Fig. 5B, **47**) and a reference electrode (Fig. 5B, **46**) with an electrolyte disposed there between (Fig. 5B, **45**), wherein the first electrode and reference electrode are in ionic communication (Col. 8, lines 16-18), and a reference gas channel in fluid communication with the reference electrode and an exterior of the sensor (Fig. 5B, **55**), wherein the reference gas chamber has a diffusion limiter (Fig. 5B, **56** and **52**).

Regarding claims 2-4, Kojima discloses that the sensor has a diffusion limit current of 0.3-20 μA (Col. 3, lines 5-8). The width of the sensor is 3.5 mm (Col. 4, lines 45-47) and in figure 2 the reference electrode working area **7a** has a somewhat square

shape. Even if the reference electrode area were assumed to span the entire width of the sensor (3.5 mm), the area would be a maximum of 12.25 mm^2. Therefore the limiting exhaust flux in the reference channel is about 0.0024 – 0.16 mA/cm^2, which is less than 10 mA/cm^2.

Regarding claims 10 and 11, Kojima discloses that the reference gas channel further comprises an oxygen storage material (platinum) (Col. 5, lines 32-45 or Fig. 5B, **46b** and Col. 4, lines 63-66).

Kojima discloses the limitations of claim 15, wherein the gas sensor is co-fired (Col. 5, line 64-Col. 6, line 8).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 5-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kojima.

Kojima applies to claims 1 and 3, as discussed previously.

Regarding claims 5-9, Kojima discloses various ways in order to limit the exhaust gas flux in the reference gas channel, such as controlling the diffusion rate in the lead portion of the reference electrode (Col. 5, lines 32-45), providing a clearance or gap along the surface of the reference electrode (Fig. 5B, **55**), and the use of a porous diffusion controlled layer (Fig. 7, **95** or Figs. 8A and 8B, **115**).

Claims 5 and 6 are drawn to a product-by-process limitation, wherein the design of the reference gas channel is determined by Equations (I) and (II), which are based on

the exhaust gas flux and pump current, respectively. Presumably, any reference gas channel can be designed according to these equations because no limitation or restriction is placed on any of the variables of the equation. Although Kojima does not disclose that the reference gas channel design is determined by these equations, Kojima does disclose controlling the exhaust gas flux by the design of the reference gas channel, as discussed previously, and control of the diffusion limiting pump current by a diffusion limit cover over the reference gas channel (Col. 3, lines 5-8). "[E]ven though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process." In re Thorpe, 777F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985) (citations omitted). The reference gas channel of Kojima is sized and designed in accordance with a desired exhaust gas flux and pump current through the gas sensor and, absent a showing to the contrary, is structurally and functionally equivalent to the inventions as claimed in claims 5 and 6.

Claims 7-9 are drawn to a reference gas channel with specific dimensions. The gas sensor of Kojima is 35 mm in length, 3.5 mm wide and 2.2 mm in total thickness (Col. 4, lines 45-48). Kojima does not disclose expressly the dimensions of the reference gas channel, however the sensor dimensions are similar to those of the instantly claimed invention. The selection of dimensions of the reference gas chamber

is considered to be routine design choice and it would be obvious to one of ordinary skill in the art to design the reference gas chamber with the dimensions specified in claims 7-9.

Claims 10 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hoetzel in view of U.S. Patent Number 5,326,597 to Sawada et al. (Sawada).

Hoetzel applies to claim 1, as discussed previously.

Regarding claims 10 and 11, Hoetzel does not disclose expressly that the reference gas chamber comprises an oxygen storage material.

Sawada teaches the use of cerium oxide as an oxygen storage material in an exhaust gas sensor (Col. 1, lines 25-32).

Hoetzel and Sawada are analogous art because they are from the same field of endeavor, that is electrochemical exhaust gas sensors.

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to include an oxygen storage material of Sawada in the gas sensor of Hoetzel in order to ensure a constant oxygen concentration at the reference electrode.

Therefore, it would have been obvious to combine Hoetzel with Sawada to obtain the inventions as specified in claims 10 and 11.

Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hoetzel in view of Japanese Patent Application Publication Number 11-183436. The English-language equivalent, U.S. Patent Number 6,623,618 to Kato et al. (Kato), is referenced in this office action.

Hoetzel applies to claim 12, as discussed previously.

Regarding claim 13, Hoetzel does not disclose expressly that the reference gas channel further comprises a second chamber and a second diffusion path.

Kato teaches the use of multiple chambers (Fig. 1, **24** and **26**) with different cross-sectional areas (see Fig. 1), each separated by a diffusion limiting path (Fig. 1, **20** and **22**) in a gas sensor.

Hoetzel and Kato are analogous art because they are from the same field of endeavor, that is electrochemical exhaust gas sensors.

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to include a second chamber and a second diffusion path of Kato in the gas sensor of Hoetzel because multiple chambers would allow the simultaneous detection of more than one component of the exhaust gas, such as O_2 and NO_x. It would have been obvious to make the second chamber larger than the first chamber because the selection of dimensions is considered to be routine design choice and it would be obvious to one of ordinary skill in the art to design the reference gas chambers with different cross-sectional areas.

Therefore, it would have been obvious to combine Hoetzel and Kato to obtain the invention as specified in claim 13.

Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over either Murase or Kojima in view of U.S. Patent Number 4,559,126 to Mase et al. (Mase).

Murase and Kojima each apply to claim 1, as discussed previously.

Regarding claim 14, both Murase (Col. 12, lines 32-35) and Kojima (Fig. 5B, **43**) disclose that the gas sensor further comprises a heater for maintaining the sensor at an elevated temperature.

Neither Murase nor Kojima disclose expressly that the heater is connected to the reference electrode via a resistor.

Mase teaches a gas sensor (Fig. 4), wherein the sensor further comprises a heater (Fig. 4, **10**) and a resistor (Fig. 4, **34**), wherein the resistor is connected to a positive heater lead (Fig. 4, **11**) and to the reference electrode (Fig. 4, **5**).

Murase, Kojima and Mase are analogous art because they are from the same field of endeavor, that is electrochemical exhaust gas sensors.

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to include a resistor between the heater and reference electrode of Mase in the gas sensor of either Murase or Kojima in order to control the current to the heater, as taught by Mase (Col. 6, lines 42-49).

Therefore, it would have been obvious to combine either Murase or Kojima with Mase to obtain the invention as specified in claim 14.

Claims 16, 17 and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over either Murase or Hoetzel in view of either U.S. Patent Number 4,292,158 to Muller et al. (Muller) or U.S. Patent Number 4,384, 935 to De Jong.

Regarding claims16 and 17, Murase discloses a method for operating a gas sensor (Col. 9, line 55-Col. 10, line 22), comprising using a gas sensor (Col. 9, line 55), the sensor comprising a first electrode (Fig. 4, **60**) and a reference electrode (Fig. 4, **64**) with an electrolyte disposed there between (Fig. 4, **52**), wherein the first electrode and reference electrode are in ionic communication (Col. 9, lines 49-54), and a reference gas channel in fluid communication with the reference electrode and an exterior of the sensor (Fig. 4, **66**) and the reference gas channel further comprises a diffusion limiter (Fig. 4, **62**), introducing an exhaust gas to the first electrode (Col. 2, lines 64-68), applying a current between the reference electrode and the first electrode to pump oxygen to the reference gas channel (Col. 4, lines 46-50) and detecting an electromotive force or voltage induced between the reference electrode and the first electrode as an output signal representative of the oxygen concentration of the exhaust gas (Col. 4, lines 50-54). Hoetzel discloses a method for operating a gas sensor (Col. 1, line 49-Col. 2, line 16), comprising using a gas sensor (Col. 1, lines 49-50), the sensor comprising a first electrode (Fig. 1, **4**) and a reference electrode (Fig. 1, **5**) with an electrolyte disposed there between (Fig. 1, **3**), wherein the first electrode and reference electrode are in ionic communication (Col. 1, lines 51-53), and a reference gas channel in fluid communication with the reference electrode and an exterior of the sensor (Fig. 1, **6**) and the reference gas channel further comprises a diffusion limiter (Fig. 1, **10**), introducing an exhaust gas to the first electrode (Col. 1, lines 54-56), inducing a current flow between the reference electrode and the first electrode so that

oxygen is transported in the solid electrolyte from the measuring electrode to the reference electrode (Col. 1, line 65-Col. 2, line 3) and detecting a voltage between the first electrode and the reference electrode, which corresponds to the oxygen content in the exhaust gas (Col. 2, lines 10-16).

Neither Murase nor Hoetzel disclose expressly the steps involved in transporting oxygen across the solid electrolyte.

Both Muller (Col. 3, lines 1-19) and De Jong (Col. 3, lines 24-52) teach a method for operating a gas sensor comprising a first electrode, a reference electrode and an electrolyte comprising the steps of applying a voltage to the reference electrode, ionizing oxygen at the first electrode, transferring the ionized oxygen across the electrolyte to the reference electrode, forming molecular oxygen at the reference electrode, ionizing the molecular oxygen at the reference electrode and transferring the ionized oxygen back across the electrolyte to the first electrode to create a voltage.

Murase, Hoetzel, Muller and De Jong are analogous art because they are from the same field of endeavor, that is electrochemical exhaust gas sensors.

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to incorporate the steps of ionizing oxygen, transferring the oxygen ions across the electrolyte, forming molecular oxygen at the reference electrode, forming

oxygen ions at the reference electrode and transferring the oxygen ions back across the electrolyte of either Muller or De Jong in the method of operating a gas sensor of Murase or Hoetzel because these steps merely detail the physical process involved when a voltage is applied between two electrodes separated by a solid electrolyte in the presence of a gas such as oxygen.

Therefore, it would be obvious to combine either Murase or Hoetzel with Muller or De Jong to obtain the inventions as specified in claims 16 and 17.

Hoetzel discloses the limitations of claim 28, wherein the reference gas channel comprises a first chamber (Fig. 1, **6**) disposed adjacent to the reference electrode (Fig. 1, **5**), wherein the first chamber has a cross-sectional area greater than a diffusion limiter (Fig. 1, **10**) cross-sectional area.

Claims 16-27, 31 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kojima in view of Muller or De Jong.

Regarding claims16 and 17, Kojima discloses a method for operating a gas sensor (Col. 6, lines 9-50), comprising using a gas sensor (Col. 6, lines 9-11), the sensor comprising a first electrode (Fig. 5B, **47**) and a reference electrode (Fig. 5B, **46**) with an electrolyte disposed there between (Fig. 5B, **45**), wherein the first electrode and

reference electrode are in ionic communication (Col. 8, lines 16-18), and a reference gas channel in fluid communication with the reference electrode and an exterior of the sensor (Fig. 5B, **55**) and the reference gas channel further comprises a diffusion limiter (Fig. 5B, **52**), introducing an exhaust gas to the first electrode (Col. 2, lines 15-17), applying a voltage to the reference electrode (Col. 2, lines 27-34), ionizing the oxygen in the exhaust gas (Col. 2, lines 27-28), forming oxygen at the reference electrode (Col. 2, lines 44-45), transferring oxygen to the first electrode (Col. 2, line 45) and measuring the voltage (Col. 2, lines 46-47).

Kojima does not disclose expressly that the oxygen is ionized at the reference electrode and the oxygen ions are transported back across the electrolyte to the first electrode.

Both Muller (Col. 3, lines 1-19) and De Jong (Col. 3, lines 24-52) teach a method for operating a gas sensor comprising a first electrode, a reference electrode and an electrolyte comprising the steps of applying a voltage to the reference electrode, ionizing oxygen at the first electrode, transferring the ionized oxygen across the electrolyte to the reference electrode, forming molecular oxygen at the reference electrode, ionizing the molecular oxygen at the reference electrode and transferring the ionized oxygen back across the electrolyte to the first electrode to create a voltage.

Kojima, Muller and De Jong are analogous art because they are from the same field of endeavor, that is electrochemical exhaust gas sensors.

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to incorporate the steps of ionizing oxygen at the reference electrode and transporting the oxygen ions back across the electrolyte to the first electrode of either Muller or De Jong in the method of operating a gas sensor of Kojima because these steps merely detail the physical process involved when a voltage is applied between two electrodes separated by a solid electrolyte in the presence of a gas such as oxygen.

Therefore, it would be obvious to combine Kojima with Muller or De Jong to obtain the inventions as specified in claims 16 and 17.

Regarding claims 18-20, Kojima discloses that the sensor has a diffusion limit current of 0.3-20 μA (Col. 3, lines 5-8). The width of the sensor is 3.5 mm (Col. 4, lines 45-47) and in figure 2 the reference electrode working area **7a** has a somewhat square shape. Even if the reference electrode area is assumed to span the entire width of the sensor (3.5 mm), the area would be a maximum of 12.25 mm^2. Therefore the limiting exhaust flux in the reference channel is about 0.0024 – 0.16 mA/cm^2, which is less than 10 mA/cm^2.

Regarding claims 21-25, Kojima discloses various ways in order to limit the exhaust gas flux in the reference gas channel, such as controlling the diffusion rate in the lead portion of the reference electrode (Col. 5, lines 32-45), providing a clearance or gap along the surface of the reference electrode (Fig. 5B, **55**), and the use of a porous diffusion controlled layer (Fig. 7, **95** or Figs. 8A and 8B, **115**).

Claims 21 and 22 are drawn to a product-by-process limitation, wherein the design of the reference gas channel is determined by Equations (I) and (II), which are based on the exhaust gas flux and pump current, respectively. Presumably, any reference gas channel can be designed according to these equations because no limitation or restriction is placed on any of the variables of the equation. Although Kojima does not disclose that the reference gas channel design is determined by these equations, Kojima does disclose controlling the exhaust gas flux by the design of the reference gas channel, as discussed previously, and control of the diffusion limiting pump current by a diffusion limit cover over the reference gas channel (Col. 3, lines 5-8). "[E]ven though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process." In re Thorpe, 777F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985) (citations omitted). The reference gas channel of Kojima is sized and designed in accordance with a

desired exhaust gas flux and pump current through the gas sensor and, absent a showing to the contrary, is structurally and functionally equivalent to the inventions as claimed in claims 21 and 22.

Claims 23-25 are drawn to a reference gas channel with specific dimensions. The gas sensor of Kojima is 35 mm in length, 3.5 mm wide and 2.2 mm in total thickness (Col. 4, lines 45-48). Kojima does not disclose expressly the dimensions of the reference gas channel, however the sensor dimensions are similar to those of the instantly claimed invention. The selection of dimensions of the reference gas chamber is considered to be routine design choice and it would be obvious to one of ordinary skill in the art to design the reference gas chamber with the dimensions specified in claims 23-25.

Regarding claims 26 and 27, Kojima discloses that the reference gas channel further comprises an oxygen storage material (platinum) (Col. 5, lines 32-45 or Fig. 5B, **46b** and Col. 4, lines 63-66).

Regarding claim 31, Kojima discloses that the operations of ionizing oxygen at the first electrode, transferring the ionized oxygen across the electrolyte to the reference electrode, and forming molecular oxygen at the reference electrode, occur substantially simultaneously with the operations of ionizing the molecular oxygen on the reference

electrode, and transferring the ionized oxygen across the electrolyte to the first electrode to create a voltage (Col. 2, lines 34-48).

Kojima discloses the limitations of claim 32, wherein the gas sensor further comprises a heater (Fig. 5B, **43**) and has been co-fired (Col. 5, line 64-Col. 6, line 8).

Claims 26 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hoetzel and either Muller or De Jong, as applied to claim 16 above, and further in view of Sawada.

Regarding claims 26 and 27, Hoetzel does not disclose expressly that the reference gas chamber comprises an oxygen storage material.

Sawada teaches the use of cerium oxide as an oxygen storage material in an exhaust gas sensor (Col. 1, lines 25-32).

Hoetzel and Sawada are analogous art because they are from the same field of endeavor, that is electrochemical exhaust gas sensors.

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to include an oxygen storage material of Sawada in the gas sensor of Hoetzel in order to ensure a constant oxygen concentration at the reference electrode.

Therefore, it would have been obvious to combine Hoetzel and either Muller or De Jong with Sawada to obtain the inventions as specified in claims 26 and 27.

Claim 29 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hoetzel and either Muller or De Jong, as applied to claim 28, and further in view of Kato.

Regarding claim 29, Hoetzel does not disclose expressly that the reference gas channel further comprises a second chamber and a second diffusion path.

Kato teaches the use of multiple chambers (Fig. 1, **24** and **26**) with different cross-sectional areas (see Fig. 1), each separated by a diffusion limiting path (Fig. 1, **20** and **22**) in a gas sensor.

Hoetzel and Kato are analogous art because they are from the same field of endeavor, that is electrochemical exhaust gas sensors.

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to include a second chamber and a second diffusion path of Kato in the gas sensor of Hoetzel because multiple chambers would allow the simultaneous detection of more than one component of the exhaust gas, such as O_2 and NO_x. It would have been obvious to make the second chamber larger than the first chamber because the selection of dimensions is considered to be routine design choice and it would be obvious to one of ordinary skill in the art to design the reference gas chambers with different cross-sectional areas.

Therefore, it would have been obvious to combine Hoetzel and either Muller or De Jong with Kato to obtain the invention as specified in claim 29.

Claim 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over either Hoetzel and either Muller or De Jong and Kato, as applied to claim 29 above, and further in view of Mase.

Regarding claim 30, Hoetzel teaches that the gas sensor can further comprise a heater for maintaining the sensor at an elevated temperature (Col. 2, lines 17-20).

Hoetzel does not disclose expressly that the heater is connected to the reference electrode via a resistor.

Mase teaches a gas sensor (Fig. 4), wherein the sensor further comprises a heater (Fig. 4, **10**) and a resistor (Fig. 4, **34**), wherein the resistor is connected to a positive heater lead (Fig. 4, **11**) and to the reference electrode (Fig. 4, **5**). A 5 V DC power source is connected to the heater in order to maintain the temperature of the gas sensor at a desired temperature (Col. 6, lines 42-46). Therefore, the power is supplied to quickly ramp the temperature to the desired level from room temperature and then periodically to maintain the temperature at the desired level.

Hoetzel and Mase are analogous art because they are from the same field of endeavor, that is electrochemical exhaust gas sensors.

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to include a resistor between the heater and reference electrode of Mase in the gas sensor of Hoetzel in order to control the current to the heater, as taught by Mase (Col. 6, lines 42-49).

Therefore, it would have been obvious to combine Hoetzel and either Muller or De Jong and Kato with Mase to obtain the invention as specified in claim 30.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to R. Michelle Vestal whose telephone number is (571) 272-0524. The examiner can normally be reached on Monday-Friday, 8am-4:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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rmv /rmv/
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